COMPUTER-AIDED DISPATCH

This document describes various aspects of computer-aided dispatch (CAD). It provides only a "snapshot" of CAD today: recognizing that technology is evolving, and industry is introducing new services and capabilities at a rapid pace. This document is not intended to reflect a government position or endorse a particular service provider or manufacturer. Rather, it is provided to offer broad industry information on CAD. We invite comments to ensure that the most current information is included in our analyses.

If you have comments regarding the information contained in this document, please contact the Public Safety Wireless Network (PSWN) Program Management Office (PMO) at 800-565-PSWN or access the PSWN Program Home Page at: www.pswn.gov.

Public safety agencies rely heavily on their land mobile radio (LMR) networks for communications and coordination within and among organizations. In the past few years, commercial services such as cellular telephones and paging capabilities have provided powerful capabilities that complement existing public safety networks. It is important that public safety communities carefully evaluate, assess, and maintain current information on the expanding commercial wireless marketplace. This allows informed, objective assessments that will ultimately meet mission requirements.

The Increasing Importance of CAD

Many industries recognize the challenge of coordinating the activities of their mobile assets. These industries are rapidly adopting automated tools to improve their coordination and communication capabilities. Computer-Aided Dispatch (CAD) is becoming an increasingly important tool to coordinate large-scale mobile fleets, to improve communications and information access for both central dispatch operators and the mobile workforce, and to streamline operations. For example, trucking companies use CAD systems, in conjunction with Automatic Vehicle Location (AVL) systems, to continuously track vehicles, send pickup orders, monitor trucks carrying hazardous material, and help drivers in the event of an emergency.

What is Computer-Aided Dispatch?

CAD is a management software tool that automates and refines dispatching functions. It allows for quick and accurate incident entry, provides access to information such as databases, and fosters two-way communications between the dispatcher and mobile units. It enables a dispatch center to integrate all communications and information processing into one system.

For public safety communications, CAD provides the ability to dispatch law enforcement, fire, and emergency medical service (EMS) units from one central computer

Capability	• Identifies the capabilities of CAD within different application
Operation	• Describes the different steps of the CAD operation
Architecture	• Describes the different components of the system and their roles
Security	• Describes the level of inherent security of the service and the capability to add security measures
Cost	• Characterizes the costs typical of CAD services

Exhibit 1
Key CAD Characteristics

allowing dispatchers to coordinate public safety response and activities. CAD also integrates interactive mapping capabilities to allow dispatchers to use geographic representation to help the dispatcher locate emergencies and incident scenes. Specifically, CAD systems:

- Display pending calls, active calls, and active units
- Track the location of response vehicles
- Help dispatchers determine the best resources to dispatch based on vehicle location and status.

CAD considerations and definitions are illustrated in Exhibit 1.

Capability

CAD systems provide several underlying capabilities that can be tailored to a specific industry or operational need. CAD systems, in general, consist of software and hardware that stores information and executes dispatch support functions. In total, CAD systems include graphical user interface (GUI) features that allow users to intuitively and easily operate the system; a records management system (RMS) to store, interrelate, and allow access to information; a mapping system that allows users to easily and quickly locate incidents and resources and coordinate activities; and an AVL system to allow dispatchers to maintain updated information of fleet vehicles.

Graphical User Interface

A GUI is a window- and icon- based graphical application software tool that supports the use of a mouse or other pointing device to easily select different processing functions. In this way, CAD provides similar functionality as is provided in many personal computer (PC) applications today. The system is user-friendly, using dialog boxes and help windows to allow users to display needed screens and run the

applications. A GUI features pull-down menus, transaction icons, and hot keys to eliminate unnecessary keystrokes and offers flexibility in screen presentation. Organizations can customize displays and features to enhance their specific operational needs.

Records Management System

RMS systems are typically configured with CAD systems to provide fast and easy access to historical and recent information. They provide relational database capabilities that allow users to store historic data, interrelate data, and conduct data searches. Information from the RMS can be easily accessed and retrieved from both the CAD operator and mobile units via wireless links to the CAD.

All data taken by the dispatcher regarding incidents, locations, units, and status information are transferred from a CAD workstation for storage in an information database or the records management server. CAD systems maintain a limited database that can be enhanced by interfacing the system with an adjunct RMS. Users can send information and records, such as case reports, to the RMS from both mobile units or any computer connected to the RMS system.

RMS allows users to conduct intelligent searches. Users can retrieve information using multiple parameters (e.g., case number, vehicle ID, names, incident locations). For example, if a user is inquiring as to the current status of a case and does not have the case number, he or she can find report case information using the name of anyone involved.

CAD RMS systems can be linked with the National Crime Information Center (NCIC), with state vehicle systems, or other databases. This allows public safety officials to easily share information across organizational and regional boundaries.

Mapping

CAD systems can be enhanced with a mapping subsystem that displays geographic and status information to the dispatcher. By viewing a map on the screen that shows current call location, pending calls, and active units, dispatchers can access incident information and identify which units should be dispatched to the scene. Mapping systems are commonly referred to as geographic information systems (GIS) and use commercially available mapping software such AutoCAD, Microstation, Arc/Info, MapInfo, and Atlas Mapping.

GIS systems are integrated graphical mapping tools and relational databases in which every entity on a map has attributes associated with it stored in the database. GIS offers a fully interactive, intelligent map. The operator can query the information, or attributes, by simply pointing and clicking on graphical symbols on the map. A CAD system, integrated with GIS mapping, can assist dispatchers in providing directions to the incident and in identifying

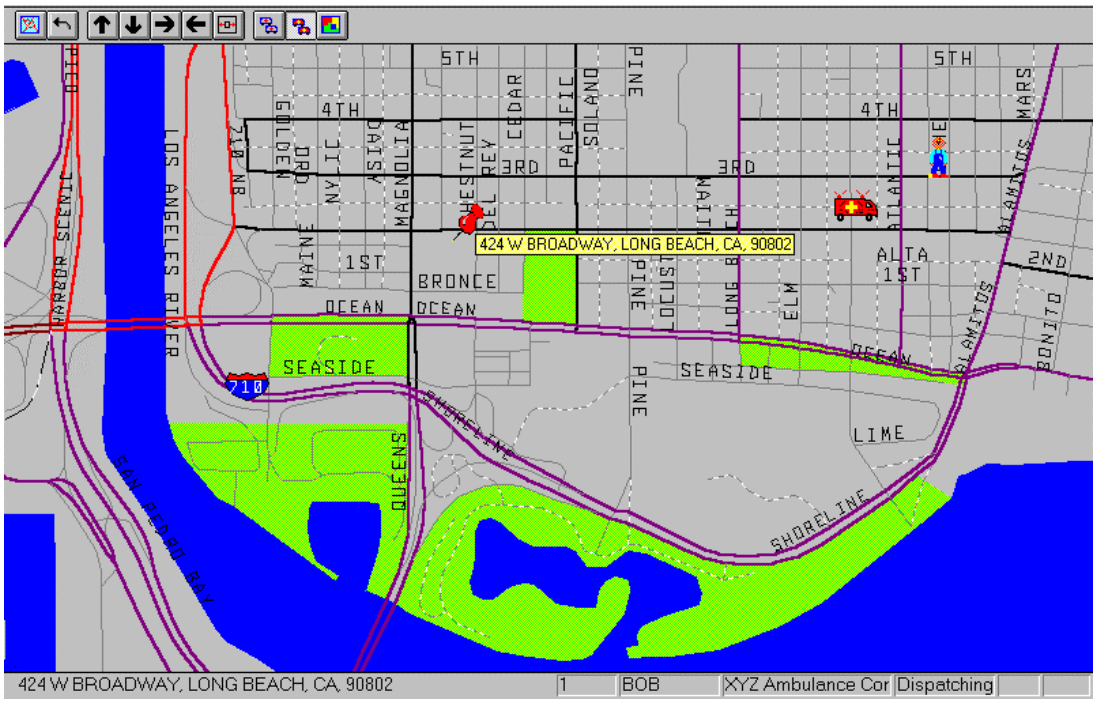

Exhibit 2
Mapping Interface Screen

what exists at a given location. Streets, highways, parking lots, fire hydrants, bus routes, power lines, lakes, rivers, and much more can be displayed. Exhibit 2 shows an example of a typical mapping interface screen. A CAD user can zoom, rotate, and pan the screen and find exact street addresses by clicking the mouse on a location on the map.

Automatic Vehicle Location

AVL is a wireless radio technology for tracking vehicles. AVL systems provide a means to electronically locate vehicles and units and communicate their location to a control center. The majority of AVL systems use global positioning system (GPS) navigational data to locate and monitor vehicles. Certain wireless service providers offer similar but less accurate locating services, that rely on terrestrial base stations rather than satellites, to triangulate location.

In the future, commercial wireless systems that provide 911 service must include AVL features. This is based on a Federal Communications Commission (FCC) ruling intended to improve 911 capabilities across all commercial services. Therefore, by October 2001, wireless service providers including cellular phone companies will be required to provide location data of every 911 call placed from a mobile phone to within 125 meters 67 percent of the time [1]. This location data will augment existing mobile unit AVL data to help dispatchers more accurately dispatch emergency units to the location of a mobile phone caller.

Current CAD mapping is based on street addresses to define location. With the addition of the FCC requirement to locate mobile phones, future CAD systems will have more sophisticated grid systems to accept different location formats, latitude and longitude.

GPS capabilities can be used to enhance AVL accuracy. GPS is a satellite-based locating and navigating utility developed by the U.S. Department of Defense. GPS provides precise positioning and navigation information on a global basis. The location information is processed by a user GPS terminal and transmitted back to a dispatch center using available satellite, cellular, or other two-way wireless services. The data can then be combined with the CAD mapping system to plot the vehicle's location on electronic maps. The system will track and continue to update the unit's position and status on the map display. An important consideration for a CAD system with AVL is the maps used in the GIS must have a precision at least as fine as the GPS signal accuracy. Otherwise, the position data in the CAD will never be reliable.

Exhibit 3 shows an example of real time navigation mapping. The vehicle being tracked is displayed in the center of the screen. Its position is updated as it moves along the street.

Other Options and Enhancements

CAD systems support an automated interface to Enhanced 9-1-1 (E-911) services. E-911 simplifies the call taking process and reduces the human error associated with data entry. Every time a 911 call is received, the caller's name, phone number, and location is automatically displayed on the screen. CAD can also support telecommunications devices for the deaf (TDD) interfaces, in which the deaf or hearing impaired can communicate with the call taker via a workstation keyboard.

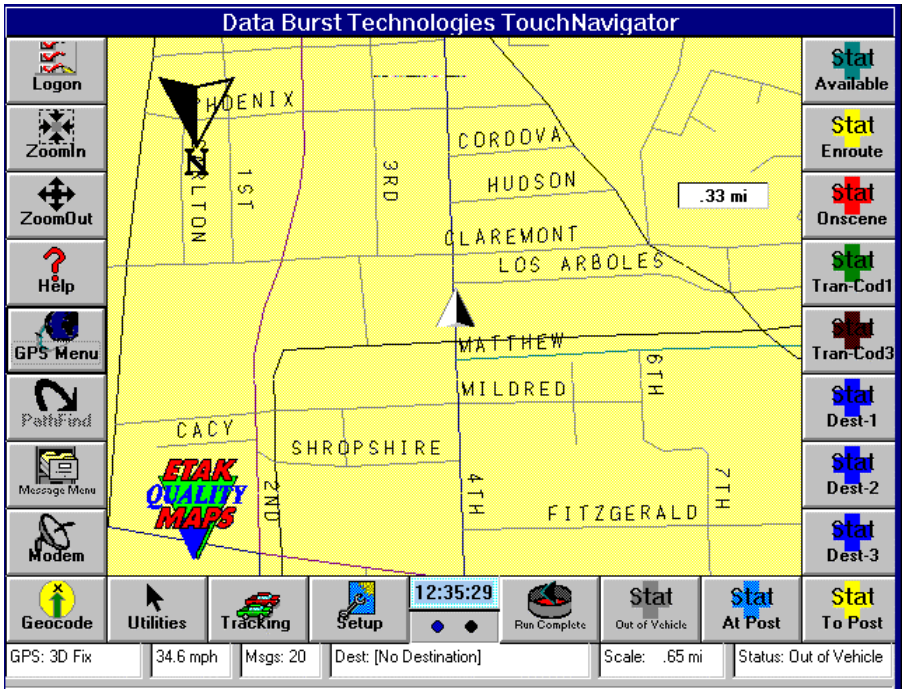

Exhibit 3
Navigation Mapping Screen

Advanced CAD systems include a range of additional features to enhance operations. Features include touch-screen monitors, alpha-numeric paging, mug shot and imaging software, and electronic mail. Advanced CAD systems have the ability to access and display real-time traffic information (from road-side video cameras) on the dispatcher's screen map. Traffic data is downloaded from the Internet or an Intelligent Transportation System and overlaid on the map to show accidents, area of heavy traffic, and congestion.

Operations

CAD systems are designed to provide an easy to use and efficient dispatching capability. When an emergency E-911 call comes into a CAD-enabled communications center, the caller's name and location are displayed immediately on the dispatching screen as the dispatcher speaks to the caller over a voice telephone line. The dispatcher then adds details concerning the emergency situation and type of help required into the CAD computer terminal. Dispatchers can determine which units should be sent to the scene of the emergency by viewing electronic maps of the area that show the locations of active response units. Through a combination of mouse and keyboard inputs, the dispatcher can then send text dispatch orders to a nearby mobile unit via two-way radio to mobile data terminals (MDT's). If MDTs are not in use, the dispatcher can switch to an LMR voice connection to audibly dispatch appropriate mobile emergency units. Exhibit 4 shows an example of a currently available and typical CAD software dispatching screen. All data is displayed on one screen, allowing the user to have more information at his or her disposal.

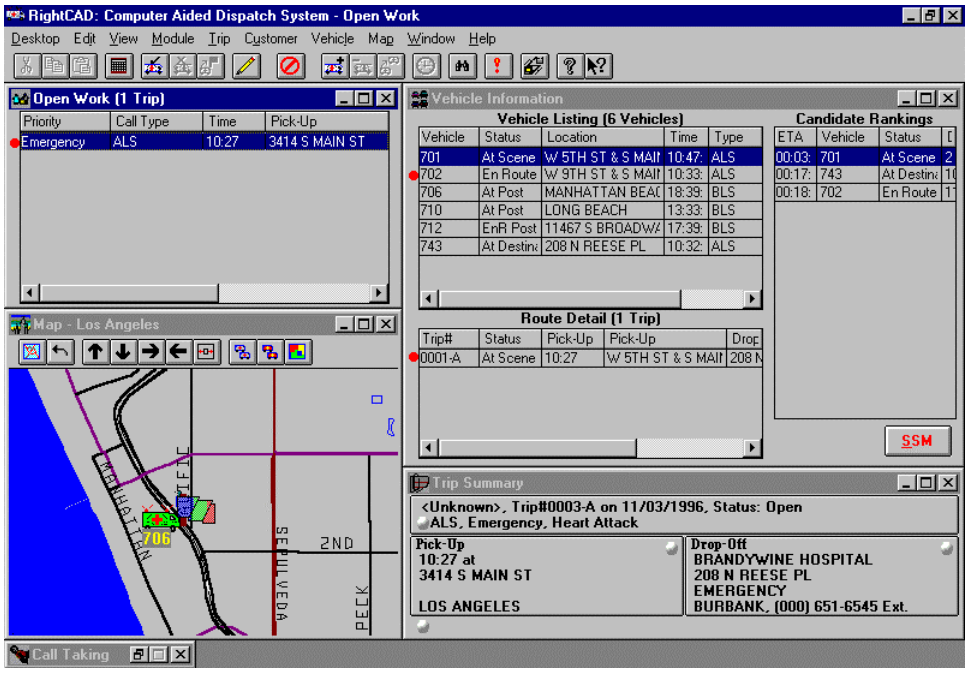

Exhibit 4
CAD Software Dispatching Screen

The screen is designed to allow a dispatch operator to easily and efficiently use a combination of mouse, keyboard, and voice inputs to perform his or her dispatching duties.

Architecture

Basic systems consist of a single dispatcher workstation or PC linked to a radio controller. Advanced CAD systems may include several CAD workstations linked together as part of a local area network including an integrated records management server and one or more radio system controllers.

Communications capabilities are essential to CAD operations. Two-way LMR and mobile data services such as cellular digital packet data (CDPD) can be linked directly to a CAD system to facilitate voice and data dispatch communications to field users. Organizations frequently integrate their CAD systems directly into the public switched network (PSN) to provide connections to 911 and E-911 calls. The PSN can also be used to dial mobile phones or pagers used by field users. A typical CAD system is shown in Exhibit 5 and consists of a CAD station, radio communications, and an RMS.

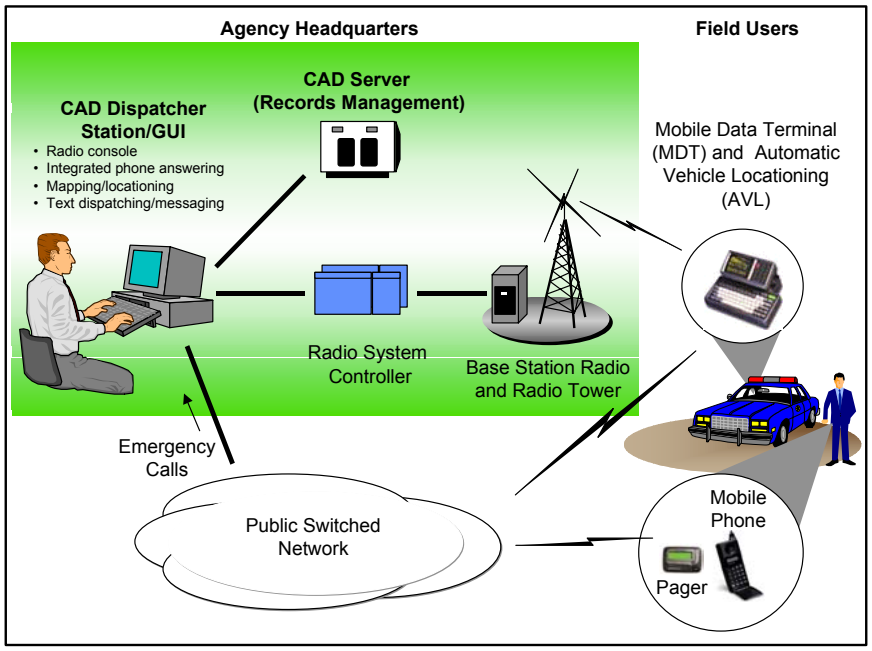

Exhibit 5
Typical CAD System Configuration and Components

CAD Workstations

A CAD workstation is usually either a UNIX-based or a Windows-based desktop computer fitted with the necessary communications and input hardware for dispatch use. In addition to a basic desktop PC configuration, a CAD workstation can include client/server dispatch software, mapping software, magnetic swipe readers, a color touch screen, a second color terminal to display mapping data, a microphone, and a telephone headset. Exhibit 6 includes a photograph of a CAD station used by a fire dispatching center. The workstation provides a dispatcher with the functions of a PC, telephone, radio base station, mapping tool, tracking tool, and database terminal all in one.

Exhibit 6
Typical CAD Station

Communications

CAD systems can be complemented by a range of wireless services and capabilities to provide communications between dispatch and mobile users. CAD can be integrated into the existing LMR system. For example, an existing trunked or conventional radio base station or controller can be interfaced into CAD workstations giving dispatchers the ability to communicate with field radios directly through a CAD station.

Organizations can also complement CAD systems with commercial wireless data services, such as CDPD. In these cases, CAD systems can be linked through an interface directly to wireless data switches allowing dispatchers to send data orders to field users and allowing field users using MDTs to make data queries remotely.

User Data Terminals

MDTs provide mobile users with computer capabilities. An MDT, as shown in Exhibit 7, consists of a small screen, keyboard, radio data modem, and antenna all designed to operate with the radio or wireless service selected by the user organization. Some MDTs are laptop computers with wireless modems that can be used in vehicles or removed for street use. Additional radio components can include GPS terminals linked through MDTs to the CAD station, mobile phones, and/or pagers.

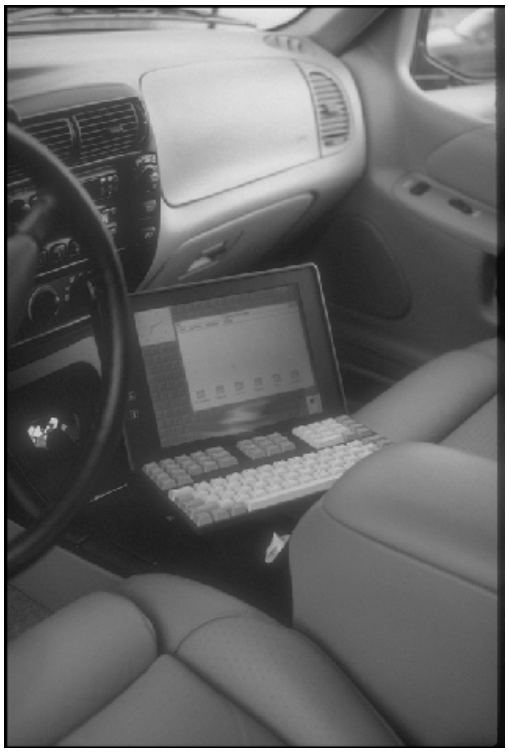

Exhibit 7
Typical MDT

Security

While the functionality of CAD systems undoubtedly increase the efficiency of dispatching operations, introducing such a computer-based system into an infrastructure may introduce significant security risks. Much of the information that a CAD system transports can be considered sensitive but unclassified and the operations that a CAD system manages are critical to an agency's mission. Potential security risks resulting from inadequately protected systems range from unauthorized access to and modification of sensitive information to disruption of agency communications.

The CAD system must be configured and managed to ensure that access to the system is available to only authorized system users. This means that privileges should be assigned to users based strictly on their job function and managed through the use of user IDs and passwords. While remote system management or maintenance is often considered a great convenience, if not securely managed, this convenience could also represent a vulnerable point of entry into the system. Therefore, the CAD system should be protected from unauthorized computer-based access (i.e., dial-up modems, network).

In general, the CAD system should be treated as an automated information system and protected as such through adequate security controls. These controls should include the secure configuration of features provided by the CAD system itself, either through the operating system platform or the CAD application. They should also include the employment of an agency security policy addressing such topics as password management, background investigations for certain types of system users, backup and storage procedures for system data, and contingency planning. Finally, depending upon system connectivity/interfaces, security controls such as firewalls and dial-back modems should be incorporated into the CAD system architecture.

Cost

CAD systems range widely in price and quality. A basic text, non-graphical single-user system can start at $500. Highly evolved CAD systems that incorporate mapping, AVL, radio system and MDT integration, records management, and other advanced features can cost over $200,000. Prices will vary depending on the number of dispatching units required and the amount of equipment and computer resources already in place. Prices can also vary based on the amount of custom designed features and enhancements requested to satisfy different customer needs. Customer support from the vendor is usually included in the purchase price or a small maintenance fee per year is charged. Site licensing for CAD systems is sometimes available.

Both up-front investment costs and recurring costs are present with the use of CAD systems. The initial cost typically includes equipment procurement, installation, and training. Recurring costs consist of maintenance (including map updates), leased-line charges, database access charges, commercial wireless service fees, and additional training.

CAD systems are typically custom configured and priced for each user. Vendors combine the software, hardware, and add-on modules to meet an individual user's requirements. As a result, specific price information is provided by vendors based on a complete customized package and not for individual components. A formal Request-for-Information may provide agencies with a tool to learn more about the costs about a CAD system able to meet specific stated requirements.

CAD Considerations

Users must carefully consider their operational requirements and the services that may satisfy those requirements. Exhibit 8 describes some considerations for using CAD. Before acquiring CAD services, potential users may choose to ask questions such as those listed in Exhibit 9 to better understand the attributes and costs of specific services. These questions should assist planners in determining whether CAD meets user requirements.

CAD Considerations

- **Efficiency —** CAD systems reduce effort and increase productivity. CAD capabilities allow dispatchers to quickly access information, improving response times and decision making.
- **Interface to Databases (Internal and Third-party) —** CAD is able to perform database searches, create detailed reports, and provide accurate and timely information to the user.
- **Standard Forms for Information Structure —** The graphical nature of GUI within the CAD system allows users to easily enter and access dispatch orders or historical information for storage into a database.
- **Incorporation of Enhanced Systems —** Most CAD system vendors make interfaces that allow it to connect to or incorporate enhanced features such as AVL, GPS, NCIC databases, and commercial wireless services.
- **Automated Error-Checking and Validation —** The computerization of dispatch through CAD technology and software allows for automated error-checking and data validation.
- **Cost —** The high cost of CAD is the most significant deterrent to utilizing its capabilities and features. The abundance of optional features and enhanced add-ons such as linking to GPS, LMR, NCIC, etc. can drive the cost of a CAD system to levels beyond what some public safety agencies and private corporations are able to afford.
- **Transition and Training —** Moving from a traditional non-computerized dispatching environment to a CAD system requires time for both system installation and testing and staff training. When MDTs are used, individual field users must also be trained necessitating both time and money during a transition period.

Exhibit 8
CAD Considerations

CAD CHECKLIST

- ☑ Do I need a CAD system?
- ☑ Where do I need a CAD system? Locally? Regionally? Nationally?
- ☑ Will a CAD system work in my operational environment?
- ☑ Will it support mission-critical requirements?
- ☑ What software and hardware is included as part of the CAD workstation package?
- ☑ What is the storage capacity of the records management server?
- ☑ What is the storage capacity and processing power of the CAD workstation?
- ☑ What add-on modules or enhanced features are included?
- ☑ Which enhanced features/services is the CAD system compatible with?
- ☑ Are software upgrades available and included?
- ☑ What type of leased-lines are necessary to link the CAD system to commercial wireless services and/or third-party databases?
- ☑ What type of training is available and included?
- ☑ Which of our existing systems is the new CAD system compatible with?
- ☑ Which additional features or components can be added to this CAD system in the future?
- ☑ What hardware beyond the CAD workstation is included?
- ☑ What additional software and hardware would be required to integrate an existing LMR network into the CAD system?
- ☑ Does the CAD system's mobile data interface with any third-party system?

Exhibit 9
User Checklist of Questions to Better Understand the CAD Service

APPENDIX A
LIST OF ACRONYMS

AVL	Automatic Vehicle Location
CAD	Computer-Aided Dispatch
CDPD	Cellular Digital Packet Data
E-911	Enhanced 9-1-1
EMS	Emergency Medical Service
FCC	Federal Communications Commission
GIS	Geographic Information System
GPS	Global Positioning System
GUI	Graphical User Interface
LMR	Land Mobile Radio
MDT	Mobile Data Terminal
NCIC	National Crime Information Center
PC	Personal Computer
PMO	Program Management Office
PSN	Public Switched Network
PSWN	Public Safety Wireless Network
RFI	Request-for-Information
RFP	Request-for-Proposal
TDD	Telecommunications Devices for the Deaf

APPENDIX B
REFERENCES

1. FCC 97-402, Memorandum Opinion and Order, "Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems," December 23, 1997, FCC Docket 94-102 RM-8143.

APPENDIX C
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